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BULLETIN ON COLOR BLINDNESS.

The importance of differentiating between those who are dangerously color blind—that is, unable at all times to distinguish between red and green—and those who are only slightly color blind is brought out in a recent study conducted by Surg. George L. Collins, United States Public Health Service, and published as Public Health Bulletin No. 92. The following conclusions were reached:

Conclusions.

Color blindness is best detected by testing with colored lights of known spectral composition.

The Edridge-Green lantern will satisfactorily divide the color blind into the dangerously color blind and the harmlessly color blind, after an understanding of the principles of the test is gained.

The Jennings self-recorded worsted test should not be used for testing sailors or trainmen, but possesses certain practical features which render it superior to other tests where great accuracy and classification of color defects are not essential.

Among healthy individuals in America, color blindness occurs in about 8.6 per cent of men and 2.2 per cent of women. Dangerous color blindness occurs in about 3.1 per cent of men and 0.7 per cent of women.

Among refractive conditions of the eye, color blindness occurs least frequently in eyes apparently without demonstrable refractive error and most frequently in eyes showing mixed astigmatism.

PHOSPHOROUS AS AN INDICATOR OF THE "VITAMINE" CONTENT OF CORN AND WHEAT PRODUCTS.

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Previous work by the writers has demonstrated that the vitamines are not evenly distributed throughout the corn and wheat kernel. Thus it was shown that the starchy part of these cereals is very deficient in vitamines, whereas the other portions of the grain (bran and

germ)[1] contain a considerable amount of these substances. These results were obtained from experiments on fowls by feeding the particular cereal product in question and noting the time necessary for the appearance of polyneuritic symptoms. When the symptoms appeared after an average of two to three weeks on a given diet, the diet was considered as containing only an insignificant amount of antineuritic vitamine. In case the symptoms appeared after three to four weeks the product was regarded as being deficient, but not entirely lacking in this substance. Finally, if no symptoms appeared within 60 days or longer, the diet was considered adequate in this respect.

Information concerning the fat soluble vitamine was furnished by growth experiments on mice and squabs. In this case it was determined whether or not it was necessary to supplement a particular corn or wheat product with fat-soluble vitamine, in the form of butter fat, in order to produce growth in these animals. When the product did not lead to practically normal growth, in spite of the fact that the other dietary deficiencies of the food with the exception of the fat-soluble vitamine were corrected, the product was considered as being deficient in this substance.

These biological procedures for the approximate estimation of the vitamine content obviously have the great disadvantage of being time consuming. On the other hand, chemical methods for the direct quantitative determination of vitamines are not available. Under these circumstances the search for more convenient means, which would permit at least a rough estimate of these food accessories in cereal foods, is urgently needed.

So far as the fat-soluble vitamine is concerned, an estimation of the fat content of the cereal product might yield the necessary information, inasmuch as it has been found that the germ seems to contain most of the fat as well as the fat-soluble vitamine of the grain. The following figures very clearly show the differences in the fat content of the most important corn and wheat products:

CORN.[2]	Fat in per cent.	WHEAT.[3]	Fat in per cent.
Corn (whole)	3.62	Wheat (whole)	2.74
Corn grits	.48	Flour, patent	1.45
Corn meal	1.41	Flour, low grade	3.86
Germ	23.79	Germ	15.61
Bran	6.71	Bran	5.03

There seems to exist a similar relationship between the fat content and the antineuritic substance of wheat and corn foods. In practice this theoretical deduction may very well prove of value.

[1] The terms bran and germ are applied throughout this paper to mill products of a varying degree of purity. Thus the germ is not the pure embryo of the grain, but is always contaminated with some bran. The bran always contains a small amount of the starchy part of the cereal.

[2] Winton, Burnet and Bornmann, U. S. Dept. Agr. Bull. No. 215 (1915).

[3] Richardson, Cl. U. S. Dept. Agr. Bull. No. 4 (1884).

However, the present investigation was confined exclusively to the relation between phosphorus and vitamine content, for the reason that previous work with rice milled to various degrees had demonstrated the intimate relation between phosphorus and antineuritic vitamine. Thus, Fraser and Stanton (1909) [1] on the basis of a wide experience with beri-beri in the East went even so far as to reject as unsafe any rice with a phosphoric oxide content of less than 0.4 per cent when this food formed the principal article of the diet.

The object of the present communication is to correlate the phosphorus content of corn and wheat foods with their content in antineuritic and fat-soluble vitamine. Special emphasis is placed on the distribution of phosphorus in the various products obtained from modern corn and flour mills.

Experimental.

The phosphoric oxide determinations were made on samples dried at 110° C. to constant weight. Five to ten grams of the dried sample are ashed by the Neumann method. Considerable patience is required in the early stages of the process to prevent excessive foaming. It has been found advantageous to allow the sample to remain in contact with concentrated sulphuric acid for about 24 hours before the ashing with nitric acid takes place. The ashed material is neutralized with ammonia until it is alkaline to litmus. After cooling, enough water is added to bring up the volume to about 250 cubic centimeters and the solution made just acid with nitric acid (litmus). One cubic centimeter of 10 per cent nitric acid and 25 cubic centimeters ammonium nitrate [2] are then added. The flask containing the solution is then immersed in a water bath, kept at 65° to 68° C. After the contents of the flasks have reached this temperature, a sufficient amount of molybdate solution [3] acidified by mixing 5 cubic centimeters of concentrated HNO_3 (sp. gr. 1.42) with 100 cubic centimeters of molybdate solution, is added with constant shaking.

The flasks are then heated for 15 minutes in the water bath. The yellow ammonium phosphomolybdate precipitate is now at once filtered off through a Gooch crucible with asbestos filter. The filtrate is always tested for complete precipitation by adding a fresh amount of ammonium nitrate and molybdate solution and reheating in the water bath. The flask and the precipitate are well washed with a 1 per cent ammonium nitrate solution until neutral to litmus, and finally with a little distilled water. The precipitate is now returned to the flask with the addition of about 200 cubic centimeters of distilled water. To this mixture N/2 sodium hydroxide, measured from a burette, is added until the yellow precipitate is completely dissolved. There should be 5 to 10 cubic centimeters of alkali in excess. One cubic centimeter of neutral phenolphthalein solution is added as indicator and the solution immediately titrated back with N/2 sulphuric acid until the pink color just disappears.

The difference between the sulphuric acid and the sodium hydroxide represents the amount of N/2 sodium hydroxide used to neutralize the insoluble precipitate $(NH_4)_3PO_4 12MoO_3$.

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[1] Fraser and Stanton. 1909. Studies from the Institute of Medical Research, Federated Malay States. The etiology of beri-beri.

[2] Prepared as follows: 3,750 gm. of ammonium nitrate, C. P., are dissolved in 2,500 cc. of hot distilled water; after cooling to room temperature this solution is diluted with distilled water to 5,000 cc. and filtered.

[3] This molybdate solution is prepared as follows: 100 gm. of molybdic acid are dissolved in 144 cc. of ammonium hydroxide (sp. gr. 0.90) and 271 cc. of water. This solution is poured slowly and with constant stirring into a mixture of 489 cc. of nitric acid (sp. gr. 1.42) and 1,149 cc. of water contained in a large porcelain dish. This mixture is kept in a warm place for several days, or until a portion heated to 40° C. deposits no yellow sediment, and preserved in glass-stoppered bottles.

One cubic centimeter of N/2 NaOH is equivalent to 1.5440 milligrams P_2O_5.

In regard to the phosphoric oxide determinations, it should be pointed out that the procedure just described will yield reliable results, as shown by the striking agreement of duplicate analyses. However, the results obtained by this method can not be compared with results obtained by other methods, as different analytical procedures will yield slightly different results.

The following tables give the results of the phosphorus determinations, as well as an estimate of both the antineuritic and fat soluble vitamines of these cereal products. The data referring to the vitamine content are taken from two previous papers by the authors.

In order to illustrate the distribution of the phosphorus of the original grain in the course of roller milling, Table 4 is offered. For a better understanding of this table a brief outline [1] of the process of milling is added.

The wheat as received by the mill is first put through a cleaning machine, which is known as the "milling separator." This consists of a series of metallic sieves. The perforations of the first two sieves are just large enough for a kernel of wheat to pass through, and therefore, oats, straw, and other impurities larger than wheat are separated from the wheat. The lowest sieve of the series has perforations considerably smaller than a kernel of wheat, which permit the smaller mustard seeds and other impurities to pass through.

From the milling separator the wheat is passed through the "wheat scourer," which consists of an upright perforated cylinder, in the center of which, revolving about the shaft, are large beaters. The wheat falls down in the center, is struck by the beaters, and is thrown against the outer case, and after revolving a number of times against the casing is passed through the bottom of the cylinder. While it is falling through the cylinder, a strong air current, passing upward, carries off the dust from the scourings.

The wheat (61)[2] now passes to the first set of corrugated rolls. After passing through these rolls it (62) goes into one end of a long reel, covered with coarse bolting cloth. The middlings (63) pass through the cloth and what remains of the wheat goes to the second reduction rolls, which are similar to the first.

This process is repeated five times, and after the middlings are taken out after the fifth reduction, all that is left of the wheat is the bran (79).

Before the middlings can be reduced to flour, the fine bran and dust must be taken out of them, or, in other words, they must be purified. Before purification can be accomplished thoroughly the middlings must be divided into various grades with respect to size. This is accomplished by running the middlings into one end of a long reel which is covered with bolting cloth of various degrees of fineness. On the head of the reel is a very fine cloth through which the flour passes; the next section is covered with a coarser cloth through which the first grade of middlings passes; the cloth of the next section is still coarser, and so on up to the end of the reel. What is too coarse to go through the last section of the reel passes over the end and is called the coarsest middlings (68).

After the middlings are graded they pass on to the "middlings purifier." This is a long narrow sieve with a strong current of air passing upward through the cloth. The middlings travel from one end of the sieve very gradually to the other end. The air current carries off the fine dust into a dust collector, and the fine bran, being lighter than the middlings, is suspended by the air current from the cloth, while the middlings go through the cloth. The bran (69) is carried by the current of air to the tail of the machine, and is thus separated from the middlings (70).

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[1] We are indebted for this description and the samples referred to in Table 4 to the manager of one of the largest flour mills in this country.

[2] The figures given in parentheses in this and the following paragraphs correspond with those of the diagram and represent the serial numbers of the samples used for the phosphorus determinations.

This process is the same for the various grades of middlings. After the purification the middlings are reduced similarly to the whole wheat, except that instead of corrugated rolls smooth rolls are used. The coarsest grade of middlings is ground, then passed on to a reel, covered with a very fine cloth, through which the flour (74) passes and goes to the flour bin. Particles of the middlings that are too coarse to pass through the cloth go over the end of the reel to another set of rolls and are ground again. This process is repeated for all grades of middlings until all have been reduced to flour. The "clears" and lower grades of flour are made from the fine bran and dust that are taken out of the middlings during the process of purification. This is done by grinding between smooth rolls the fine bran and dust. The bran will not break up, but flattens out. The product is passed on to a reel covered with fine cloth, through which the flour passes. This flour contains very fine particles of bran which it is impossible to separate from it, and therefore this flour can not be run into the highest grades of flour. It is sold as either "first clear" (75), "second clear"(76), or "red dog" (77), according to the amount of bran it contains.

Conclusions.

The phosphoric anhydride determination of wheat and corn products yields fairly satisfactory information as to the content of these products in accessory foods. A low phosphoric anhydride content indicates that the product is poor in vitamines.

TABLE 1.—*Corn products—Content in P_2O_5 and vitamines.*

Sample No.	Nature of product.	Source.	Degree of milling.	P_2O_5 in per cent.	Estimated vitamine content (from feeding experiments).	
					Fat-soluble vitamine.	Antineuritic vitamine.
1	Corn, whole	Connecticut	Not milled	0.77	Relatively high.	High.
2	....do	California	....do	.84	....do	Do.
3	....do	Indiana	....do	.73	....do	Do.
4	....do	Tennessee	....do	.69	....do	Do.
5	....do	Alabama	....do	.57	....do	Do.
6	....do	Georgia	....do	.61	....do	Do.
25	Corn meal	Georgia (buhr mill).	Undermilled; considerable bran and germ.	.77	....do	Do.
27	....do	South Carolina	....do	.79	....do	Do.
83	....do	Tennessee (buhr mill).	....do	.67	....do	Do.
32	....do	Georgia (buhr mill).	....do	.66	....do	Do.
31	....do	South Carolina (buhr mill).	....do	.67	....do	Do.
36	....do	....do	....do	.63	....do	Do.
33	Corn grits	....do	....do	.67	....do	Do.
30	Hominy	....do	....do	.64	....do	Do.
38	Corn bran	....do	Undermilled; contains some germ.	.78	Doubtful (not estimated).	Fairly high. Prevents polyneuritis when added to highly milled corn grits in proportion of 10 gms. to 35 gms.
7	Corn germ	Indiana (roller mill).	Germ plus traces of bran.	2.81	High	High.
18	Corn meal	Maryland (roller mill).	Highly milled	.29	Low	Very low. Produced polyneuritis in 3 weeks.
17	Corn grits	North Carolina (roller mill).	....do	.13	....do	Do.
9	....do	Mississippi State Hospital.	....do	.18	....do	Do.
10	....do	Georgia	....do	.17	....do	Do.
11	....do	Georgia (U. S. penitentiary).	....do	.20	....do	Do.
12	....do	Mississippi	....do	.17	....do	Do.
15	....do	South Carolina	....do	.18	....do	Do.

TABLE 2.—*P_2O_5 content of various products from same run of corn (Maryland roller mill).*

Sample No.	Nature of product.	Appearance.	P_2O_5 in per cent.
37	Corn	Whole	0.80
39	"Table meal"	Considerable bran and germ	.81
40	"Table hominy"	No bran or germ	.17
41	"Cream meal"	....do	.16
43	Corn flour	White: no bran or germ	.21
42	Corn germ	Largely germ; little bran	2.57
44	Corn bran	Largely bran	.69

TABLE 3.—*Wheat products—content in P_2O_5 and vitamines.*

Sample No.	Nature of product.	Source.	Degree of milling.	P_2O_5 in per cent.	Estimated vitamine content (from feeding experiments).	
					Fat-soluble vitamine.	Antineuritic vitamine.
49	Wheat (whole)			1.12	Considerable	High.
61	....do			1.01	....do	Do.
86	....do	South Carolina		.89	....do	Do.
85	"Graham" flour from wheat No. 86.	South Carolina (buhr mill).	Undermilled	.86	....do	Do.
92	"Graham" flour	....do	....do	.82	....do	Do.
84	Wheat bran	....do	Undermilled; white material adhering to cellulose.	2.12	Probably deficient (not estimated).	Do.
97	"Whole-wheat" flour.	Missouri (roller mill).	Undermilled; contains some germ and bran.	.62	Considerable	Do.
98	"Red dog" feed	Washington, D. C. (roller mill).	Undermilled	.92	....do	Do.
103	"White" middlings.	....do	....do	1.65	....do	Do.
101	"Brown" middlings.	....do	....do	1.88	....do	Do.
88	Wheat flour from No. 86.	South Carolina (buhr mill).	Highly milled	.26	Very deficient	Deficient.
91	"Patent" flour	Virginia	....do	.20	....do	Very deficient.
94	....do	Michigan	....do	.21	....do	Do.
95	....do	Maryland	....do	.25	....do	Do.
93	....do	South Carolina	....do	.22	....do	Do.

Diagram of flour milling process and distribution of phosphorus.